Turbulent Transport Study Using a Simple Experiment for understanding of Complex Systems

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Turbulent transport is a very general subject in a wide area of physics research. The phenomena that we are interested in are very complex ones associated with structure formations in turbulent plasmas. In many cases of our interest, some structures appear in turbulence due to "symmetry breaking" such as gravity, temperature gradient, density gradient, intensity gradient of turbulence, rotation, velocity shear, magnetic field, etc. We have proposed a new experimental approach to turbulent transport using ElectroHydrodynamic Convection (EHC), which comes from the "**Cross-Fertilization**" among laboratory plasmas, astrophysics, non-linear physics communities.

The EHC is a convection motion driven by the electric field in a liquid crystal, where the gravity and the temperature gradient in a Rayleigh Bernard convection (RBC) system can be replaced by the electric field alone. When the electric field is increased, the EHC becomes turbulent, which is the same feature as RBC with stronger buoyant force. The Rayleigh number and the Prandtl number can be controllable independently in this experiment. The experimental results of turbulent transport with symmetry will be presented in this talk. The effective diffusivity can be experimentally defined and is observed to increase with Rayleigh number, which is identical to turbulent transport in normal fluids (Navier-Stokes system). In order to investigate the effects of rotation on the turbulence and turbulent transport, the experiment has been carried out on a rotating stage. The changes of spectra of EHC turbulence and a generation of non-linear coupling have been observed to be induced by rotation, which may be a symmetry breaking effect due to axial vector (rotation) in turbulence.